Method and Device for Object Detection

Field of the Invention

The present invention relates to a method and a device for detecting an object.

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Background Information

A method for object detection having at least two distance-
determining sensors attached to a motor vehicle, the detection
10 regions at least partially overlapping and relative positions
of possible detected objects with respect to the sensors in
the overlap region being determined according to the
triangulation principle, is described in German Patent
Application DE 199 49 409. Possible apparent objects
15 resulting from object determination are identified in this
process via dynamic object monitoring. Such known methods for
determining the position of objects use the distance lists of
similar individual sensors as input quantities. In this
context, similar means that these individual sensors have the
20 same aperture angle. The maximum horizontal sensing range of
typical sensors of this type is +/- 55 degrees, for example.
Therefore, at a distance of approximately 14m, each sensor
covers a region of approximately +/- 6m in the lateral
direction. This means that numerous interfering objects on
25 the road edge, such as trees, bushes, or posts, are sensed in
addition to relevant objects, such as traffic members.
Moreover, significant measurement data need to be determined,
such that a plurality of reflection centers may be detected
even for relevant objects, so that it is not ensured that
30 every sensor is detecting the same reflection center. As a
result of these facts, it is not ensured for all traffic

situations that relevant and interfering objects are able to be clearly identified even when using more than two sensors. It is also possible for objects to be displayed at incorrect positions.

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Summary

The present invention provides an object detection method that is capable of increasing the reliability. The improved

10 ability to differentiate between relevant objects and interfering objects allows the position of relevant objects to be determined even more precisely. In addition, the concentration of at least one sensor on the particular road region makes it possible to increase the coverage while

15 maintaining the same radiated power.

Brief Description of the Drawings

Figure 1 shows use of the conventional object detection method

20 for a traffic situation on a roadway having a plurality of lanes.

Figure 2 shows use of an example embodiment of the method of the present invention for a traffic situation on a roadway

25 having a plurality of lanes.

Detailed Description

A conventional method, including its disadvantages, is

30 explained on the basis of Figure 1. Shown is a traffic situation on a roadway 10, which includes a plurality of lanes 10.1, 10.2, 10.3. Particular vehicle 1 travels in center lane 10.2 and approaches two other vehicles 3 and 4 traveling in the same direction in adjacent lanes 10.1 and 10.3. Vehicle 1

is equipped with distance sensors S1, S2, S3, the at least partially overlapping sensing ranges of which sensors are designated as ES1, ES2, ES3. Under particularly unfavorable conditions, the detection of different reflection centers may result in the system as a whole displaying a non-existent apparent target in addition to vehicles 2 and 3. Such an apparent target appears to be in region 4, i.e., in lane 10.2 of vehicle 1. The edge regions of sensing ranges ES1, ES2, ES3 overlap in region 4. Such a result clearly leads to a false reaction of the system, i.e., the vehicle would react with a braking operation. This would result in significant uncertainty on the part of the driver of vehicle 1 since the driver, trusting the system display, erroneously believes that an obstacle is located in front of own vehicle 1 in own lane 10.2 of roadway 10 in region 4. As soon as the driver determines that this is a system error, trust in the system reliability may be lost.

The method according the present invention is explained on the basis of Figure 2. Shown is a traffic situation comparable to that in Figure 1. On a roadway 10, including a plurality of lanes 10.1, 10.2, 10.3, vehicle 1 travels in center lane 10.2 and approaches two other vehicles 3 and 4 traveling in the same direction in adjacent lanes 10.1 and 10.3. Vehicle 1 is equipped with distance sensors S1, S2, S3, the at least partially overlapping sensing ranges of which sensors are designated as ES1, ES2, ES3. At least two sensors, namely sensors S1, S3, are positioned at the front of the vehicle, essentially in one plane. A third sensor S2 is also positioned at the vehicle front between sensors S1 and S3. Sensing ranges ES1 and ES3 of sensors S1 and S3 largely overlap. Their angular expansion on a horizontal plane is approximately +/-55°, for example. This means that at a distance of approximately 14m from the front of vehicle 1,

each sensor S1, S3 having sensing range ES1, ES3 in the
lateral direction covers a region of approximately +/- 6m.
Therefore, in the case of multi-lane roadway 10 shown in
Figure 2, at least partial regions of adjacent lanes 10.1 and

5   10.3 are covered in addition to own lane 10.2. In the case of
a narrower road having, for example, only one lane for each
direction, sensing ranges ES1, ES3 of sensors S1, S3 would
sense the edges of the road and obstacles present there, in
addition to the adjacent lane. According to the present

10   invention, at least one sensor S2 has a sensing range ES2, the
angular expansion of which is significantly less than that of
sensing ranges ES1 and ES3. The angular expansion of sensing
range ES2 may be so small that essentially only own lane 10.2
is covered for the maximum sensing range, as shown in Figure

15   2. Such a limitation of the horizontal sensing range of
sensor S2 allows a selection of relevant object reflections to
be made under the assumption that objects outside own lane
10.2, i.e., vehicles 2 and 3 in lanes 10.1 and 10.3, are no
longer detected by sensor S2. An object is namely generated

20   or triangulated when it is detected by at least two sensors.
If the point of intersection of the sensing ranges of sensors
S1 and S3 are in sensing range ES2 of sensor S2 but sensor S2
does not detect an object, no object is generated in sensing
range ES2. The result is that the distance values detected by

25   sensors S1 and S3 cannot be from the same object.
Accordingly, only objects detected by sensors S1, S3 as well
as by sensor S2 are viewed as relevant targets. These are
almost exclusively objects located in own lane 10.2. In the
traffic situation shown in Figure 2, no object to be

30   classified as relevant would be displayed according to this
approach. Even the representation of an apparent target may be
effectively suppressed even under particularly unfavorable
conditions.

As a result of the possible focusing of the beam of sensor 2, its sensing range ES2, as shown in Figure 2, may extend significantly farther in the travel direction of vehicle 2 than sensing ranges ES1 and ES3 of sensors S1, S3. This is

5 possible without increasing the radiated power. The focusing may be performed via correspondingly dimensioned optical elements, such as lenses, positioned in the beam path. Since greater sensing range ES2 of sensor S2 in the travel direction of vehicle 2 allows early selective sensing of objects located

10 in own lane 10.2, a triangulation and/or tracking algorithm provided in the system or a filter method may be advantageously preconditioned. This results in a time savings that contributes to an increase in safety particularly in critical situations.

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In an advantageous further embodiment of the present invention, sensing ranges ES1 and ES3 of sensors S1, S3, which are responsible for the peripheral regions, may be further adjusted such that as few non-relevant objects as possible are

20 detected. Therefore, the sensing coverage of sensing ranges ES1 and ES3 may be shortened such that vehicles approaching own lane 10.2 may be detected early but far away objects on the road edge are no longer detected. The sensing range in the immediate vicinity of vehicle 2 is not significantly

25 affected by the described measures so that parking operations continue to be reliably supported.

The solution of the present invention may be implemented in an essentially cost-neutral manner since already available

30 standard sensors may be adapted accordingly. A sensor functioning in another frequency range, e.g. 77 GHz band, already proven in an ACC system (ACC = Automatic Cruise Control) may be used in some instances for sensor S2.

In an advantageous further embodiment of the present
invention, the sensing angle and/or sensing coverage of
sensing range ES2 of sensor 2 is/are adaptable to the
particular road conditions such that an optimal adjustment to
5   the road type and the dependent width of the existing lanes
results. As a result, sensing range ES3 may be optimally
adapted to roadways having only a singe lane or a plurality of
lanes. This adjustment may be performed manually by the
driver who operates a corresponding switch having a plurality
10   of switch positions when entering a certain road category,
e.g., when merging onto a highway. However, in a particularly
advantageous manner, sensing range ES2 may also be
automatically adapted to the road category, e.g., via coupling
with a navigation system provided in vehicle 2 or via a GPS
15   system. As soon as the navigation system determines that a
certain road type is being driven on, a corresponding
adjustment signal is sent to the system for determining the
position of objects.

20   In a further advantageous embodiment of the present invention,
such an adjustment of sensing range ES2 is performed by the
system for determining the position of objects in that the
signals of sensors S1 and S3, which are responsible for the
peripheral regions, are evaluated accordingly. If for example
25   these sensors sense a large number of objects in their sensing
ranges, it may be derived that the particular sensing range
extends too far beyond the edge region of the road. The width
of the sensing range would then be able to be reduced
automatically.